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ABSTRACT

The purpose of this study was to examine how end-users participate in the evaluation of multimedia programs in North America. Questionnaires were sent to over 100 projects (26 returned) focusing on instructional objectives. Results are discussed in terms of graphics, the user/machine interface, costs, program design, quality indicators, such as help and feedback availability and user control, team production, end-user participation, and the overall product quality, The following conclusions were made: (1) 50 percent of the educational programs were "information distribution programs"; (2) the hypermedia model is widely suited; (3) there was continuous evaluation during the production of the program and participation of end users in this evaluation; (4) an objective mechanism for quality control is not systematically used; (5) the multimedia programs depend heavily on the text; (6) the mouse is the most common interface for the user; and (7) the multimedia conception of communication is being used at a high and costly level by developers and at a low level by professors, due to authoring tools, and because there is no consideration of the personal costs, the differences between budgets have no relation to the quality of results. (Contains 25 references.) (AEF)

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Interactive Multimedia in Western Education

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ED 389 288

This research was developed during the last months of 1994, in the University of Calgary, By Dr. Lauran Sandals (University of Calgary, Canada) and Dr. Antonio Bartolomé (Universitat de Barcelona, Spain). The stay of Dr. Bartolomé in Calgary was sponsored by the Subdirección General de Promoción de Investigación, Ministerio de Educación y Ciencia, Spain. The content of this report has been prepared by Antonio Bartolomé.

During these years, several people have directed to me, asking "how have I to produce a multimedia programme for learning purposes?". And, usually, they waited an answer as "put this kind of graphics, in this place, with this sound,..." I think that a book as "Multimedia Programmes Production guidelines" would be a success of selling.

In 1994 I arrived to conclusion that the question was correct, but the answer that everyone could find in several books were wrong: *the bad answer for the good question*. This is not a new situation. During a travel by plane I asked to Dr. David V. Williams (Ithaca College) about the tools that they used to develop multimedia software, and he answered me: "Oh, it is simple, the *brain*!". This time I was waiting the *bad* answer ("Toolbook, AuthorWare, HyperCard...") for a *good* question. And he gave me the *good* answer.

So, which is the *good* answer to the questions about "Multimedia Production guidelines"? I arrived in 1994 to the conclusion that the answer was not in the specific resources or techniques used but in the general role of *Evaluation* (you can in some way understand it as "Quality control") and the role of *End-users* in the production process. Later, during 1995, the European Community has introduced these aspects as key issues in the funded project.

So, between January and December of 1994 Dr. Lauran Sandals and me, we interviewed several people involved in Multimedia programmes production processes in NorthAmerica. Although we sent questionnaires to more than 100 projects, we received only feed-back from 26. The length and, perhaps, the kind of some questions, discouraged for other people to answer these questions. With these answers, some of the initial objectives related with the definition of Multimedia Programmes profiles were given up. Here we will explain only some conclusion related with the first aim of this research: "To develop a revision of Multimedia projects developing processes in Educational context, in North-America (US and Canada), relating Evaluation and end users participation techniques with the global quality of these products.

1. Theoretical Context

The research about media in Education has traditionally been more involved in resources application than in production aspects. Thus, we have some interesting works as the revisions of Clark (1983) about the benefits of new media from the

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old ones. Or the meta-analysis of Kulik (Kulik et Alt., 1980) when they found an effect size of 0.51 between with and without media teaching programmes, effect that was reduced to 0.13 when both control and experimental groups had the same professor. Or the revision of Bosco (1986) when he found that, while the 100% of the research without statistics tests reported benefits from the use of media, only the 50%, more or less, reported when statistics tests were in use. Other aspects have been considered and from different perspectives in the research on Instructional Media as Clark (1991), relating to cognitive issues and, also, to economic issues.

Inside the Production aspects, the research has been specially oriented to Design, and Screen Design. Morrison et Alt. (1991) offer a revision about the research applications to the Design of CBI. They consider three aspects: the screen design, the control of the program, and the amount and type of feedback provided the learner.

The research about the screen design is wide and deep. Works as these ones from William G. Sweeters (1985) and Madge, et Alt. (1986) summarized some of the more known results in this area. Or, from a more complex perspective of the interface, that is, including other elements as sound, the work of Lauran Sandals (1987). Some aspects related with the screen design have to be reconsidered because the important changes in screen resolution and color, more the new photo and video realistic possibilities.

The study of learner control has been studied by several colleagues, included my self in a previous work over Interactive video (Bartolome, 1992). Despite the results -see also Pridemore and Klein (1991)- developers seem not to be conscious of the problems related with the user control of the programme, specially at lower educational levels, perhaps because the need of "democratic environments" as described by Schwier and Misanchuk (1993).

An interesting way has been the application of old results to new problems as in Collis (1991). The Multimedia has born in a context where some conclusions from other instructional media could be applied with some restrictions.

Some special aspects related with the design of as-hypertext multimedia programmes have been studied as Shneiderman (1987) or Yankelovich et Alt. (1988). A more open revision of this issue can be found in the well documented work of Jacob Nielsen (1990).

In this short revision of some of the key subjects of the research that can be applied to educational multimedia programmes, we will end with the work over hardware. Different devices have been studied as the keyboard (Noyes, 1983; Litterick, 1981), Light pens (Whitefield, 1986), Mouse, Touch Panel (Karat et Alt. 1986), etc. A more global perspective of the human-computer interface can be found in Barker (1989).

The research in the application and design has been the key issue during the last years. But we asked for new trends in the research about multimedia production with more effective and practical results. An original idea was suggested by Hodges and Sasnett (1993) when said (p. 40): "Deriving from the philosopher Nelson Goodman's observations on art, the proper question should not be *what* is good design, but *when* is good design. For our purposes we can define good design as effective communication. When a message is communicated effectively, then there is good design... The design of an interface depends entirely on what it will be used for".

But, as they recognized, that seems do not say a lot about how to produce multimedia programmes. But this idea includes a key element: the validity of the design is related with the use... and, that implies, with the *user*. So, in a development process, the role of the user could be important in order to achieve a success in the final product.

Which role? The end-users have not necessarily good skill in designing, drafting, painting, recording video,... and it is logic to suppose that they will be unfamiliar with the contents of the programme. So, it is clear that its role is situated primarily in the side of the evaluation and quality control.

So, this is the main objective of this work: to present how the end-users participate in the evaluation (can we use "quality control"?) of multimedia programmes in North America.

2. Methodological Considerations

The study runs over two stages. The first one is that we are going to present here and includes the answers to a questionnaire, and the analysis of some publications about the projects. The sample includes 26 programmes multimedia specifically referred to educational and instructional objectives. The data come from different people directly related with these programmes, usually involved in Coordination roles.

These 26 programmes represent the work of more than 160 people during an average time of 2 years. This work costed more than $ 300,000 in direct expenses, more the human cost that could be estimated according to the average salary in between 2 and 3 millions of dollars.

These programmes are actually 95'multimedia. Near every one began in the ninety's decade (figure 1) and the last versions ended between 1993 and the data collect time (figure 2). More than 80% of them were finished in 3 years or less and the most in 1 or 2 years (figure 3).

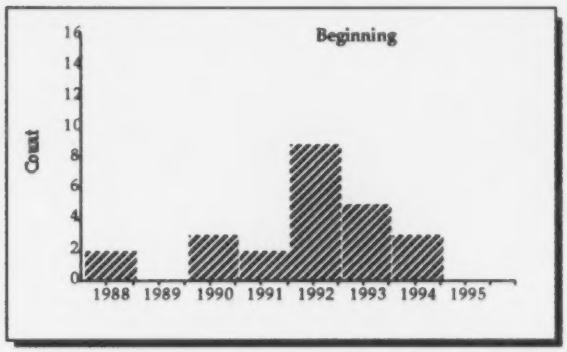

figure 1

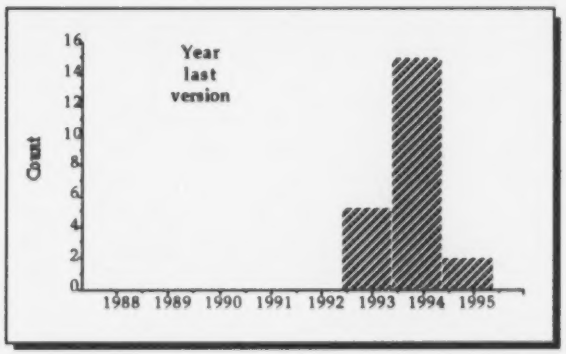

figure 2

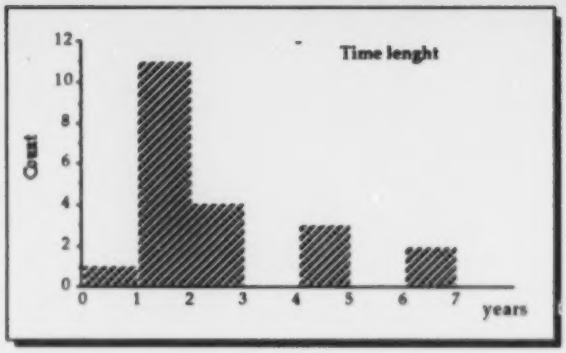

figure 3

The most of the programmes are oriented to Academic uses, and a few ones to Teacher Education (figure 4). So this sample is not representative of Industry multimedia programmes. That is a consequence of the objective of this work and of the sample selection process. This is coherent with the average cost (less than in Industry), the average development time (more than in Industry), and the used tools (authoring languages).

Some projects were addressed to more than one level (Primary, Secondary...). This is an interesting characteristic in some Instructional programmes: it seems that words, pictures and graphics could be the same for a teenager, than for children or for 22 years old people, with different previous knowledge (e.g. vocabulary).

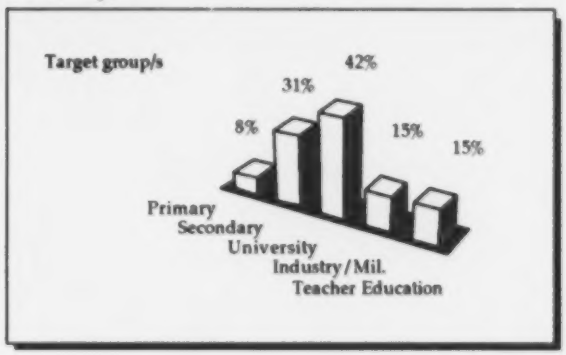

figure 4

About the contents, these are oriented to Science and Technology (figure 5). In "Other" there are programmes with educational contents, History of Art, Management, Adult literacy.

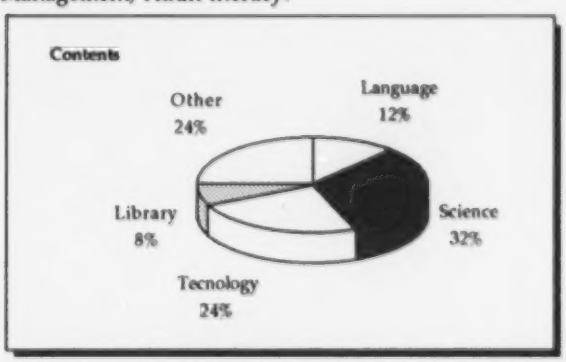

figure 5

The programmes were between first and fifth version (figure 6). Some of them were considered unfinished, and there were a general vision that a multimedia programme is never definitive.

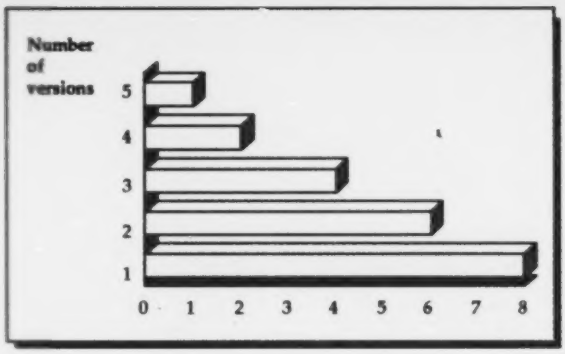

figure 6

About the Operative system, half and more have worked with Macintosh (figure 7), with a percentage that does not differ from the other data (Barker, J., 1995).

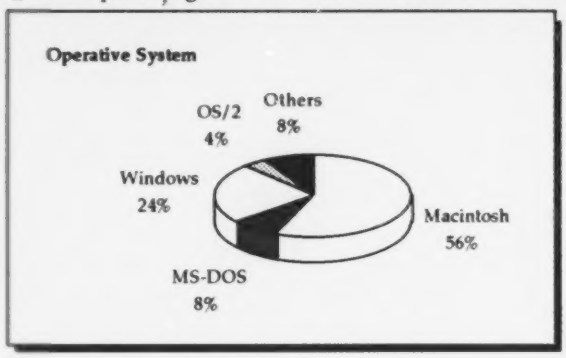

figure 7

This information is relevant, as the Authoring Language (table 1). Note that sometimes are used more than one language.

Table 1

Hypercard	8
C	6
Director	3
ToolBook	2
Tencore	2
Common Lisp	2
Linkway	1
IconAuthor	1
Authorware	1
Visual Basic	1
Xwindow	1
Hyperstudio	1
SmallTalk	1
Other	1

In around the 40 % the developers have used tools according to the "Hypertext" paradigm (Hypercard, ToolBook, Linkway,...). Certainly you must to consider the lower relative cost and the more open character about distribution licenses (Hypercard vs. Coursebuilder, toolbook vs. IconAuthor or AuthorWare...). Surely this is a difference between Academic and Industrial multimedia programmes (where e.g. Authorware is most used).

Other aspect: in the 57% of the cases when the Macintosh computers are used, Hypercard is the selected language. MacroMind Director is the second one. About the "classic" programming languages, "C" has the most acceptation.

How were these programmes? In the next point you will find some results.

3. Results

Graphics, text, sounds...?

The "text" is the winner!. In 52 % of the programmes, there is TEXT in EVERY SCREEN (figure 8), while in 44% of the programmes there are not VIDEO SEQUENCES NEVER.

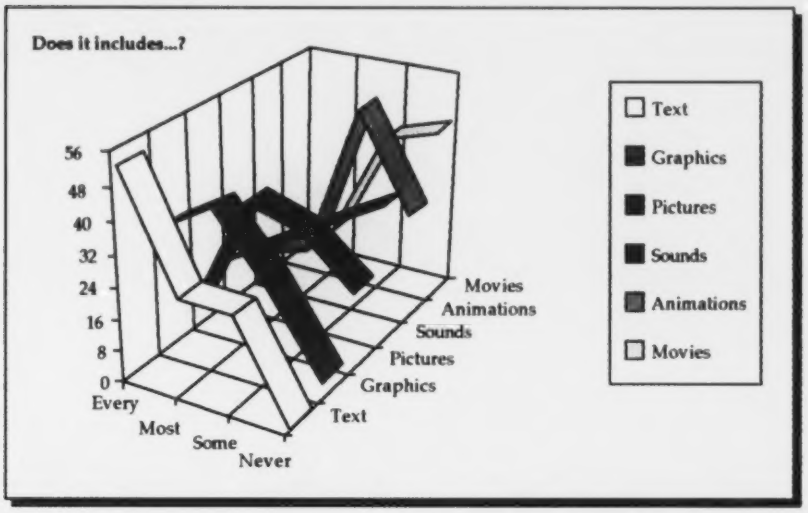

figure 8

The use of these elements is conditioned by the characteristics and needs; so, it is reasonable that Animations and Video-sequences are used only sometimes (52% and 40%). But, if we study in how many programmes they are not used NEVER (figure 9) is clear that multimedia programmes have a big dependence from the written text. Sure, it is difficult to design a programme without text (but, is it impossible?), but 75% of the programmes had text in EVERY ONE or THE MOST of the screens!!!.

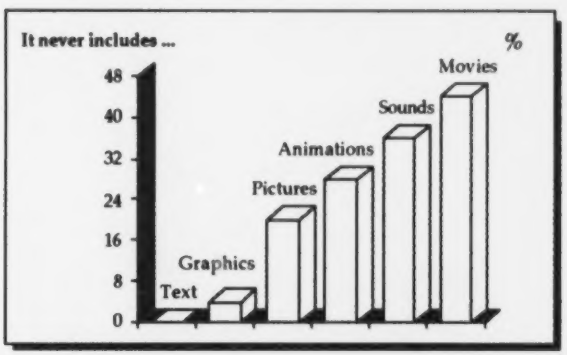

figure 9

The technical restrictions do not explain these results. Actually, if we apply contingency tables of this data with the Operative System, we do not find significant differences ($0.4 < p < 0.5$, according to the element). But every Macintosh has a built-in speaker, and the most a microphone! So, there is not significant relation between the introduction of sound in a multimedia programme and the capacity of the hardware.

We can find a justification in the production costs could, but it is difficult to consider that the Audio production is more expensive than Animations production. Other consideration could be related with the design of programmes oriented to be used individually in shared rooms.

I have the feeling that the programmes reproduce an academic Communication conception, far away from the conception of the media (e.g. TV).

The interface: from the man/woman to the machine

The mouse is the preferred interface (figure 10). The keyboard has today a secondary place. And Voice and VideoCapture (TO the computer) have a small role. At this moment, the most of the Macintosh includes microphone and its Operative System lets to accept instruction and to work with this device. It could be interesting to note the movement to these systems in the next years. Some developments in the field on AI will be critics for the introduction of these interfaces in the future.

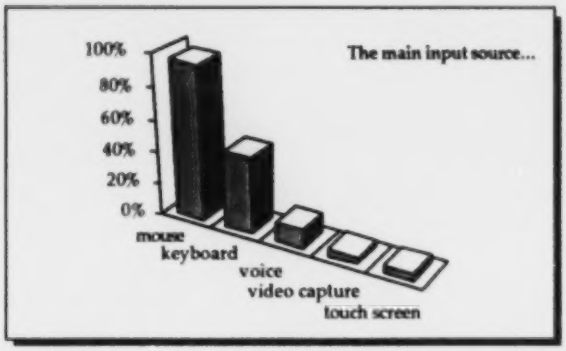

figure 10

Money, money, money...

This is a remarkable aspect because the high cost of multimedia production. However, in this case it is possible to find very "cheap" programmes: the 25% have needed less than $ 1,000. It is necessary to note that the personal costs were not included (figure 11).

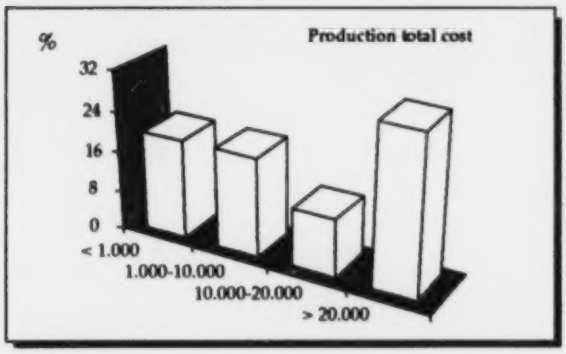

figure 11

How to recuperate this cost? Near the half of the programmes are being sold (figure 12).

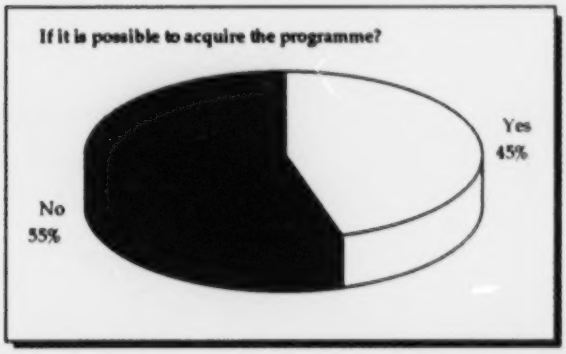

figure 12

This is more usual in the programmes with higher costs (Table 2).

table 2

Percents of Column Totals

	<1.000	1.000-10.000	10.000-20.000	>20.000	Totals:
Yes	25%	40%	33.33%	71.43%	47.37%
No	75%	60%	66.67%	28.57%	52.63%
Totals:	100%	100%	100%	100%	100%

The Design of programmes

It is possible to consider the instructional design of the programmes from different perspectives (Schwier and Misanchuk, 1993; Anglin, 1991). We used our own taxonomy, justified in other sites (Bartolomé, 1994, 1995): In the domain of Information Presentation Programmes we include 3 models: Multimedia Book, Encyclopaedia and Hypermedia. In the domain of Learning Activities Programmes, other four models are showed: Practice, Tutorial, Problem Solving and Simulation.

Actually, a programme could be included in more than one of these categories; however, it is possible to obtain some conclusions (Table 3).

table 3

		Learning Activities?		
		Yes	No	
Basically Information?	Yes	40%	8%	48%
	No	52%	0%	52%
		92%	8%	100%

This table contains some kind of contradiction if you consider the text of the two questions:

3.1 Does the programme include activities or questions for the user? (= the programme is not only a collection of Information items)

3.3 Does the programme basically contain information that the user can retrieve? (= the programme does not contain learning activities as exercises, questions, problems, ...)

So, the 92% include some activity or question, but only the 48% include learning activities as exercises, questions, problems... So, the most of the programmes do not include learning activities although they include some kind of feed back from the user (figure 13).

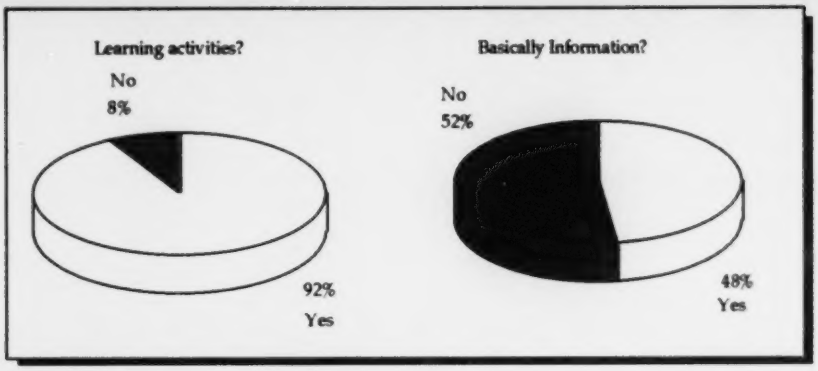

figure 13

About the design, if we consider than Practice and Tutorial models are mostly based in Behaviorist theories, the Constructivist model is not a big reference for the design of multimedia programmes (17% + 4%) (figure 14). A similar result is obtained from the contents of Statistics courses in Education related with Qualitative vs. Quantitative methods: one thing is what people say, other what people use.

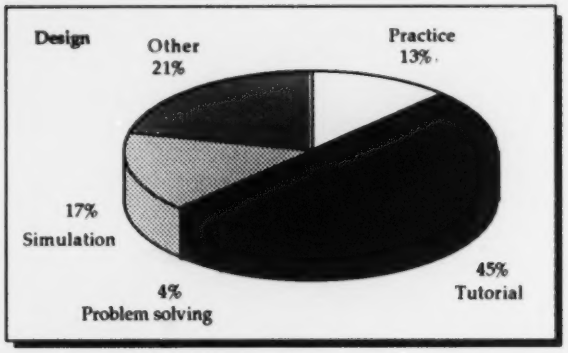

figure 14

About Information oriented programmes, the most of them are presented as Hypermedia (figure 15). The question is if they are actually hypermedia. I have found during the last years several developers that call "hypermedia" to every interactive multimedia Information programme.

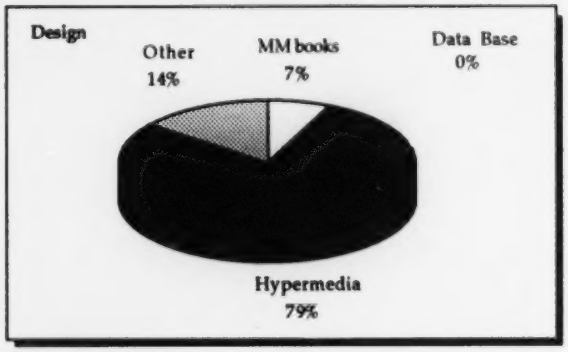

figure 15

Quality Indicators

We have tried of selecting some quality indicators:
a) That there is a help system (despite the scarce use of it)
b) The control of user over the programme
c) The possibility of different levels for different users (that is, individual differences attention)
d) Assessment (or Evaluation) system

e) Feed back to the user.

The three last are the less considered aspects (figure 16):

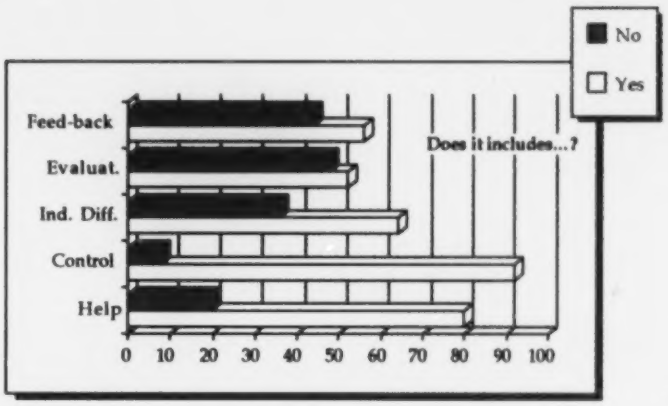

figure 16

If you consider how many of these pointers appear in each programme, only in the 12% of them the number is less than 3 (figure 17).

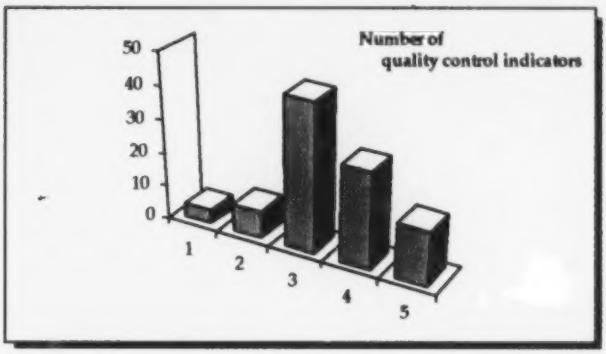

figure 17

Production

A third of the programmes were developed by 1 or 2 people. So, ¿the multimedia programmes have to be actually the result of a team work?¿ Is it possible to prepare multimedia as when a teacher prepare some notes for his/her students? (figure 18).

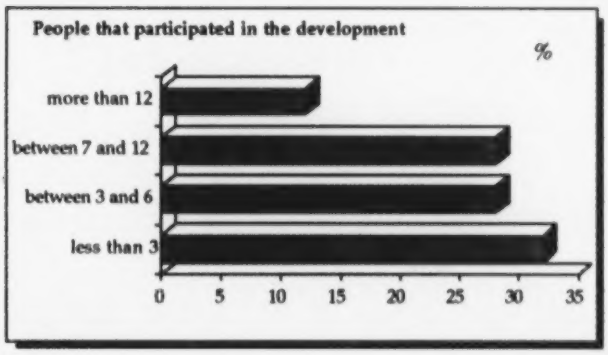

figure 18

Of course, there is a significant relation between the number of people and the cost of the programme: the 100% of the projects with less than $ 1,000 costs have been produced by one or two people (Table 4).

Table 4

Percents of Row Totals

	less than 3	3 - 6	7 - 12	more 12	Totals:
<1000	100%	0%	0%	0%	100%
$1000-10000	20%	40%	20%	20%	100%
$10000-20...	0%	66.67%	33.33%	0%	100%
>20000	12.5%	25%	37.5%	25%	100%
Totals:	33.33%	28.57%	23.81%	14.29%	100%

Several authors consider that the script is the most relevant stage in the production of a multimedia programme in order to get the best results. We can consider that the number of people involved in the script is a quality indicator. In this case, the quality would be higher because only the 20% of the script are the work of one person (figure 19); the result is more significant if you consider that the 30% of the programmes have been produced with only 1 or 2 people.

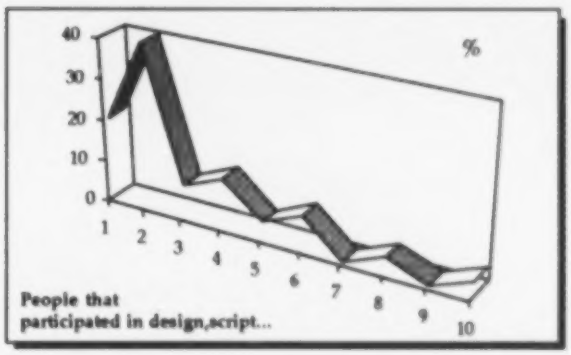

figure 19

Assessment & Evaluation

Two thirds of the programmes were evaluated during and at the end of the production process (figure 20).

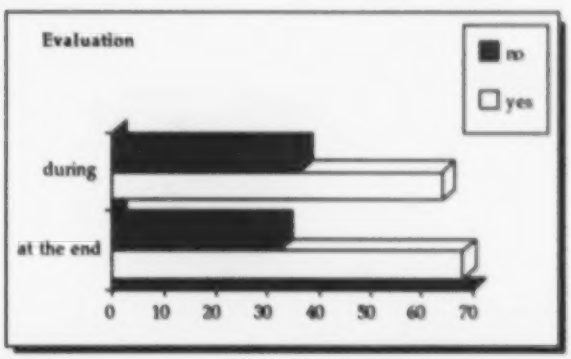

figure 20

This is an interesting result and more considering that this evaluation or quality control is similar independently of the number of people involved in the project (Table 5 and 6).

Table 5

Percents of Row Totals	Yes	No	Totals:
less than 3	62.5%	37.5%	100%
f3 - 6	80%	20%	100%
f7 - 12	66.67%	33.33%	100%
more 12	66.67%	33.33%	100%
Totals:	68.18%	31.82%	100%

Table 6

Percents of Row Totals	Yes	No	Totals:
less than 3	50%	50%	100%
f3 - 6	71.43%	28.57%	100%
f7 - 12	71.43%	28.57%	100%
more 12	66.67%	33.33%	100%
Totals:	64%	36%	100%

If we consider the two kind of evaluation, the same projects that include one of them, they include the other (p=0,001).

Speaking of the evaluation "during" the production process, we took in consideration WHEN. In more than 50% of projects, the evaluation takes place in 2 moments, more the end control. Although there is not a clear taxonomy, we have found these profiles as more usual ones:
a) Who does not assess the programme never
b) Who assess the programme one time, during or at the end or process.
c) Who assess the computer software and, later, the final product.
d) Who assess the results in several stages of the production.

And these are the corresponding percentages:
profile A 25 %
profile B 15 %
profile C 15 %
profile D 45 %

End user participation

End users participated in the production of the project: two thirds. But less than 50% in the case of "evaluation during" (figures 21 and 22).

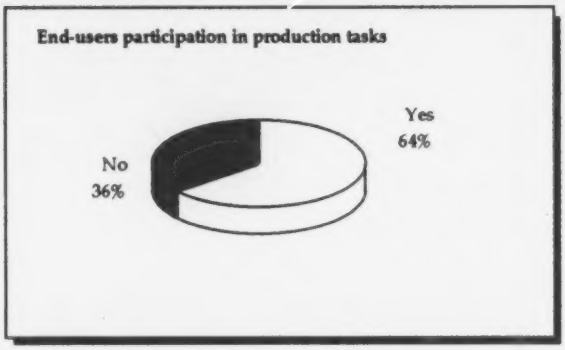

figure 21

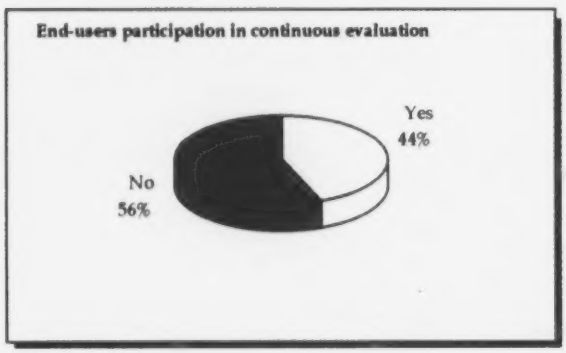

figure 22

The quality of the product

The first indicator of the quality of the programme is the self-perception of the authors (figure 23).

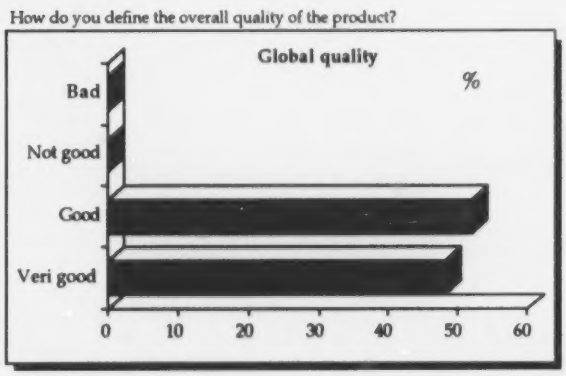

figure 23

Good!. Well, we are going to be more specific: What about the educational objectives? Do you get them? (figure 24).

Do you consider that the programme achieves its educational aims?

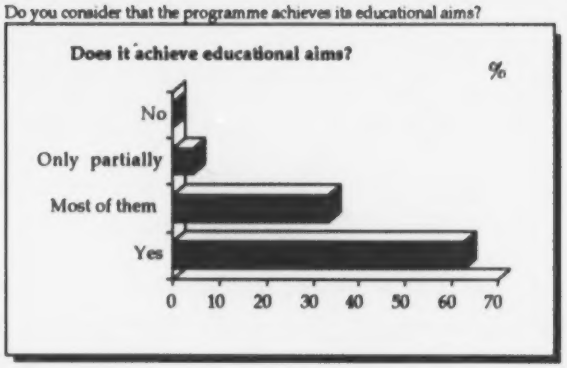

figure 24

These results are obtained also from these projects where there was not any evaluation during or at the end. It sounds the cited revision of Bosco (1986).

The more or less quality of a programme is coherent with the distribution level: the most copies distributed the most positive the evaluation of the programme (table 7).

Table 7

	Very good	Good	
less 10	4	7	11
f10 - 100	0	3	3
more 100	7	2	9
Totals:	11	12	23

A similar result related with the achievement of educational objectives (Table 8). In both cases the p is near of 0.01.

Table 8

	Yes	Most	Only part	
less 10	5	5	1	11
f10 - 100	0	3	0	3
more 100	9	0	0	9
Totals:	14	8	1	23

Feed-back from end users

In the most of the cases, the opinion of end users has been asked (figure 25).

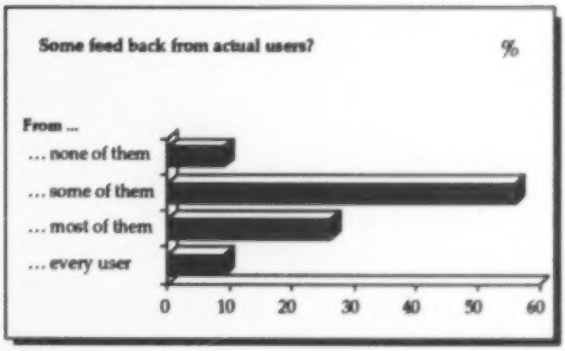

figure 25

4. Discussion

At this moment, new contacts with interviews had to take place with the developers. But we can to obtain some initial results.

These are the aspects that I have selected, but surely other people can find other more relevant from their point of view.

1. The educational programmes are in most cases (50%) "Information distribution programmes"

2. The "hypermedia" model is widely suited.

3. The continuous evaluation during the production of the programme, and the participation of end users in this evaluation, they both are notorious but they are not generalized.

4. Objective mechanism to control the quality of programmes is not systematically used.

5. The multimedia programmes have a great dependence from the text (perhaps because the kind of contents or instructional objectives).

6. The mouse is the most common interface for the user. (But, is it the more adequate in these programmes?)

7. The multimedia conception of communication is being used at a high and costly level (developers), as at a low level (professors), thanks to the authoring tools. And because the no consideration of the personal costs, the differences between budgets have not relation with the quality of results.

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